

Exploiting Human Science Advances for Military Operations: Past Challenges & Future Vision

Ira Jacobs, DrMedSc

School of Kinesiology & Health Science
York University
Toronto, Ontario, CANADA

ijacobs@yorku.ca

ABSTRACT

This paper outlines the need for defence research organizations to maintain a robust “human sciences” capability. The paper also exemplifies key points to be presented at the conference about the relevance, challenges and opportunities for new knowledge in “human sciences” to support military and national security operations.

1. THE NEED FOR “HUMAN SCIENCES”?

Although it may seem ironic to begin a paper about “human sciences” with a paragraph on technology, it is this author’s opinion that the defence research organizations of many RTO members have experienced erosion of their internal “human sciences” capabilities in order to afford the costs of investments by their organizations in technology-based R&D. Military operations today by NATO members are characterized by the operationalization of the concepts embodied in the *“Revolution in Military Affairs”* (RMA). Introduced by US Admiral William Owens (7), then Vice-Chairman of the US Joint Chiefs of Staff, the RMA symbolized the development of an integrated “system of systems” that enables a military user to employ sensors (e.g., satellites, shipborne radar, remote acoustic devices), global positioning sensors, and precision guidance munitions in concert to not only locate, fix, and “kill” military targets, but to also do so from afar. The RMA concepts were effectively demonstrated in operations during the “Desert Storm” war in Iraq.

From a strategic perspective it is tempting to speculate that high technology dependency makes it increasingly unlikely that those who are so dependent will willingly enter wars that do not have technological solutions. Conversely, is it not more probable that future potential enemies, well aware of their technological inferiority, will choose to exploit warfare strategies that are geared to avoiding at all costs technological confrontations. The current challenges in Afghanistan and Iraq could be viewed as costly examples of this perspective.

There are previous examples of the potential futility of technological superiority in such situations. Consider the October 1993 operation of the US Army Special Forces in Somalia (2). They were on a mission to capture key members of the entourage of the Somali warlord Aidid. There are few branches of the US military that possess more advanced technology at their disposal than Special Forces. A planned half-hour “snatch-and grab” mission became a 15-hour battle with horrendous consequences for the US personnel involved, consequences that should dispel the presumed invincibility of technological superiority.

To summarize the key message of this section, when technology fails, the knowledge of human capabilities and limitations is key to sustaining operations.

Report Documentation Page			Form Approved OMB No. 0704-0188	
<p>Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p>				
1. REPORT DATE OCT 2009	2. REPORT TYPE N/A	3. DATES COVERED -		
4. TITLE AND SUBTITLE Exploiting Human Science Advances for Military Operations: Past Challenges & Future Vision			5a. CONTRACT NUMBER	
			5b. GRANT NUMBER	
			5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)			5d. PROJECT NUMBER	
			5e. TASK NUMBER	
			5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) School of Kinesiology & Health Science York University Toronto, Ontario, CANADA			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSOR/MONITOR'S ACRONYM(S)	
			11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited				
13. SUPPLEMENTARY NOTES See also ADA562561. RTO-MP-HFM-181 Human Performance Enhancement for NATO Military Operations (Science, Technology and Ethics) (Amelioration des performances humaines dans les opérations militaires de l'OTAN (Science, Technologie et Ethique)). RTO Human Factors and Medicine Panel (HFM) Symposium held in Sofia, Bulgaria, on 5-7 October 2009., The original document contains color images.				
14. ABSTRACT This paper outlines the need for defence research organizations to maintain a robust human sciences capability. The paper also exemplifies key points to be presented at the conference about the relevance, challenges and opportunities for new knowledge in human sciences to support military and national security operations.				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION OF: a. REPORT unclassified			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 6
b. ABSTRACT unclassified			c. THIS PAGE unclassified	

2. DEFINING “HUMAN SCIENCES”

The phrase “Human Sciences” means something very different on the campuses of our nations’ universities than what is likely understood by those attending this NATO RTO conference. In academic circles the phrase is usually considered a synonym for the humanities, including history, anthropology, sociology, philosophy and economics, but may also encompass the social sciences. The understanding in defence science circles is different. Throughout my 25 years as a defence scientist the phrase “Human Sciences” evolved within the RTO community into one which represents an interdisciplinary field that involves the application of biological, behavioural and socio-cultural knowledge for the purposes of understanding those human capabilities and limitations of relevance to the mission of our nations’ military and national security organizations.

3. EXPLOITING “HUMAN SCIENCES”

It is not only the definition of “human sciences” that is different between civilian and military research sectors. The rationale underlying the need for such research is also very different. The difference can be succinctly summarized as follows:

“Whereas non-military research focuses on identifying and treating abnormal function in a normal environment, the objective of military human sciences research should be to sustain at least normal function in the very abnormal environments which characterize most military operations” (W. Bateman, Toronto, Canada, personal communication).

Figure 1 depicts conceptually what might be strategic, operational or tactical objectives, depending on the nature of the operations, that could be advanced more rapidly than would otherwise be the case by maintaining a very current awareness of scientific advances in human sciences disciplines. The figure depicts schematically that new knowledge in biological, behavioural or integrative sciences can be applied to enhance and/or preserve human capabilities. Similarly such new knowledge could also be used to protect or exploit human vulnerabilities. In both cases new knowledge can be applied at the level of an individual or group.

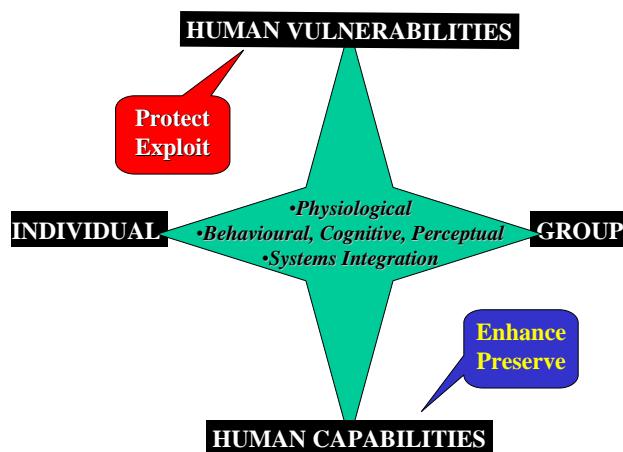


Figure 1: How Knowledge of “Human Sciences” Can Be Exploited.

4. EXAMPLES OF HUMAN SCIENCES ADVANCES YET TO BE EXPLOITED

The volume of new knowledge in human sciences and the rate of knowledge generation are so huge as to make this section of the paper outdated as soon as it is written. Thus, the intent of this section of the paper is simply to identify areas of research that exemplify some of the new knowledge which, to the best of this author's knowledge, have yet to be *systematically* considered, let alone applied, in support of military or national security operations. The focus is on knowledge that involves an understanding of human capabilities and limitations rather than on knowledge that is technology-dependent. In some cases the knowledge represents many years of knowledge evolution in a specific field; in other cases the knowledge represents a dramatic recent breakthrough. The space allowed for this paper limits the amount of new "human sciences" areas that could be potentially exploited; many additional examples will be presented at the conference.

4.1 Neurosciences and Neuroplasticity

The advances have been dramatic in this field over the last 30 years, disproving the previously widely accepted dogma of "localizationalism", i.e. that each cognitive function is processed in a genetically pre-determined location in the brain. The use of transcranial magnetic stimulation (TMS) in particular has enabled tremendous insights into brain function and adaptability in recent years. TMS is a painless and harmless method of using magnetic fields to activate neurons in humans; TMS literally replaces the need to cut open skulls and prod specific locations in the motor or sensory cortex with electrodes. TMS has been used to demonstrate how the brain re-organizes neuronal "maps" and pathways within a few days. The theory of "localizationalism" held that if a bullet destroyed a location in the brain then its function would also be permanently eliminated. But, this is not the case...there is overwhelming evidence now that the brain is plastic and capable of creating new structures to replace damaged ones (3). Moreover and in contrast with previous dogma, it has been demonstrated that living neurons form in humans until the very end of our lives (9). Related research questions are whether dormant neuronal stem cells can be activated with drugs, or whether stem cells can be induced to move to specific (injured) areas of the brain. Could neuronal stem cells be induced to move to uninjured areas of the brain and would it be beneficial?

4.2. Applied Human Physiology

This author recalls the time twenty years ago when there was a growing sentiment among defence research managers that knowledge of human physiological responses to harsh environmental stressors (e.g. heat stress, altitude, physical exertion) had reached a plateau and there was little probability of dramatic new knowledge. This led to dramatic reductions in the resources dedicated to human physiological research in a number of NATO-member defence research laboratories. Yet, the generation of new knowledge continues unabated and has resulted in totally different understandings of the mechanisms that endanger human health or limit performance in harsh environments. The applications to military and national security needs remain, for the most part, unexploited.

For example, heat-stress related injuries continue to be a serious and constant source of military casualties and fatalities in training and operations. The understanding of the physiological processes underlying severe heat stress injuries has changed immensely during the last few years. It has been repeatedly and clearly demonstrated that heat stress is associated with the release of toxins from the gastrointestinal (GI) tract and an associated general inflammatory response (8). It is now widely believed that fatalities due to heat stroke are caused as a direct result of an overwhelming inflammatory response.

The primary objective of altitude-related research in a military context in the past has been to identify individuals pre-disposed to the development of acute mountain sickness (AMS) and/or to develop pharmaceutical approaches to decrease the incidence of AMS or treat it. Recent research has demonstrated for the first time that a pharmacological strategy may be a viable approach to reducing the magnitude of the performance impairment that occurs in hypoxic environments (4).

Intriguing research carried out with children in a nomadic Burmese tribe, Sea Gypsies, demonstrated that they can see underwater much better than European children. These children are raised in an environment where they often dive up to 10 metres below the sea surface to collect their food. Most humans cannot see clearly underwater because of the refraction of sunlight. Gislen et al. (5) reported that the Sea Gypsies learned to control the shape of their eyes' lenses and the size of their pupils. Most human pupils reflexively dilate under water while the Gypsies constricted their pupils by 22%. This was an impressive demonstration of the adaptability of what was thought to be an autonomic reflex controlled by the nervous system. The same researcher subsequently showed that a similar adaptation can be rapidly taught to European children (6).

4.2. Drugs and Performance Enhancement

There is an abundance of new research demonstrating that cognitive gains, and/or avoidance of cognitive declines can be relatively rapidly achieved through pharmacological interventions. Similarly, impressive gains in physical performance can be achieved within an hour of ingestion of a relatively safe combination of drugs, improvements that would otherwise require several weeks of physical training (1). There has been a reluctance to follow-up and implement systematic applications of such drug-related knowledge in NATO member nations, perhaps because of negative public perceptions about the use of drugs by athletes to improve their performance.

4. EXAMPLES OF POTENTIAL RESEARCH QUESTIONS LEADING TO KNOWLEDGE EXPLOITATION

Creative defence scientists could think of a myriad of routes for the new knowledge mentioned above to be exploited if resources were unlimited, so such speculation will not be detailed in this paper; rather questions are posed below to demonstrate some potential exploitation routes.

- How can the new knowledge about neuroplasticity be applied in military medicine?
- Could dormant neuronal stem cells be activated with drugs, or could such cells be induced to move to specific (injured) areas of the brain. Could neuronal stem cells be induced to move to uninjured areas of the brain and would it be beneficial?
- What are the consequences of the rapid rate at which the brain can re-organize itself for training technologies and learning?
- Are there identifiable and quantifiable “markers” of a predisposition to become an “expert” in a defence or national security-related domain?
- Can the well established effects of cognitive and physical exercise on neuroplasticity be manipulated to accelerate learning and training?

- What is the role of sleep management for the facilitation of learning?
- Is a “thought reading” machine now a viable objective?
- What are the applications and consequences of the new knowledge about gender-related differences in brain anatomy, brain circuitry, and the related behavioural, perceptual and emotional differences (e.g. pain perception)?
- Can human physiological autonomic responses be so easily “trained” as to make them viable military training objectives?
- Can the incidence of military casualties due to exertional heat illnesses be significantly reduced through the prophylactic and/or therapeutic use of drugs which target the GI-related toxins and inflammatory response caused by heat stress.
- What are the potential applications of new knowledge about the physiological mechanisms underlying “altitude sickness”?
- Can human autonomic responses to military stressors be “trained” to respond in a fashion that leads to improved performance and/or reduced health risks in response to those stressors?
- Should pharmacological approaches be more widely adopted to sustain or improve cognitive and physical performance? How?
- What is known about the interaction of commonly prescribed drugs with the multitude of stressors to which military personal are exposed during operations?

5. THE CHALLENGE OF SUSTAINING AND NURTURING “HUMAN SCIENCES” FOR MILITARY APPLICATIONS

What is the best fashion for a military research organization to sustain and nurture expertise in the “human sciences”? As mentioned earlier, many NATO nations have seen a real erosion of their capabilities in related research domains and their scientists’ duties include much more time devoted to managing research and development contracts than to nurturing their own scientific expertise. Is the dependency on external (to the military organizational structure) expertise in the “human sciences” effective and efficient? My contention is that it is not and that such dependency compromises responsiveness. My experience as a defence scientist employed by my nation’s Department of National Defence, as well as my experience as a full-time academic on a university campus managing a large, multidisciplinary, human sciences-focused department, lead me to the conclusion that the embedding of defence scientists within an academic organization where the desired expertise resides is a preferred vehicle for ensuring the currency of human sciences knowledge that can be effectively and efficiently recruited to support military operations; the conference presentation details the related rationale.

REFERENCES

- [1] Bell, D. et al. Effects of caffeine, ephedrine, and their combination on high intensity aerobic exercise performance. *Eur. J. Appl. Physiol.* 77: 424-433, 1998.
- [2] Bowden, Mark. *Black Hawk Down: A Story of Modern War*. New York: Atlantic Monthly, 1999.
- [3] Doidge, N. *The Brain that Changes Itself*. New York: Penguin Books, 2007.
- [4] Ghofrani, H.A. et al. Sildenafil increased exercise capacity during hypoxia at low altitudes and at Mount Everest base camp. *Ann. Intern. Med.* 141:169-177, 2004.
- [5] Gislen, A. et al. Superior underwater vision in a human population of sea gypsies. *Curr. Biol.* 13: 833-836, 2003
- [6] Gislen A. et al. Visual training improves underwater vision in children. *Vision Research* 46: 3443-3450, 2006.
- [7] Owens, William. "The American Revolution in Military Affairs." *Joint Forces Quarterly* 10. Winter (1995-96): 37.
- [8] Selkirk, G. et al. Mild endotoxemia, NF-kappa beta translocation, and cytokine increase during exertional heat stress in trained and untrained individuals. *Am. J. Physiol.: Regul. Integr. Comp. Physiol.* 295: R611-R623, 2008.
- [9] Van Praag, H. et al. Functional neurogenesis in the adult hippocampus. *Nature* 415:1030-1034, 2002.